

TABLE 2.—Free-air resultant winds (meters per second) based on pilot-balloon observations made near 5 a. m. (E. S. T.) during June 1938—Continued

Altitude (meters) m. s. l.	Newark, N. J. (14 m)		Oakland, Calif. (8 m)		Oklahoma City, Okla. (402 m)		Omaha, Nebr. (306 m)		Pearl Har- bor, Terri- tory of Hawaii <sup>1</sup> (88 m)		Pensacola, Fla. <sup>1</sup> (24 m)		St. Louis, Mo. (170 m)		Salt Lake City, Utah (1,292 m)		San Diego, Calif. (15 m)		Sault Ste. Marie, Mich. (198 m)		Seattle, Wash. (14 m)		Spokane, Wash. (603 m)		Washing- ton, D. C. (10 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface.....	331	1.1	256	2.0	152	2.0	161	1.9	-----	-----	328	1.2	238	0.8	152	2.2	233	1.1	254	0.5	149	1.4	83	1.4	271	0.4
500.....	308	4.2	238	2.7	167	4.3	187	4.7	-----	-----	282	2.2	261	2.5	-----	-----	204	0.5	295	2.6	12	1.3	-----	-----	321	2.8
1,000.....	308	3.8	314	5.5	200	7.5	213	5.6	-----	-----	268	2.6	286	3.0	-----	-----	344	0.6	272	4.4	24	1.4	217	0.5	319	3.1
1,500.....	296	4.1	323	3.9	219	5.6	235	5.1	-----	-----	271	3.6	282	3.2	137	1.9	-----	-----	271	5.1	318	1.4	266	1.3	316	3.5
2,000.....	287	3.9	322	4.0	244	4.0	259	5.6	-----	-----	281	3.9	283	4.2	170	1.3	-----	-----	261	6.4	291	1.8	252	2.3	302	2.9
2,500.....	304	3.2	318	3.5	273	4.5	276	5.8	-----	-----	288	5.0	287	4.9	206	1.8	-----	-----	271	6.0	265	2.0	250	2.6	280	4.0
3,000.....	315	2.5	269	2.0	289	3.7	279	6.7	-----	-----	296	4.3	284	5.6	244	3.1	-----	-----	292	5.6	251	3.4	252	4.0	306	7.9
4,000.....	37	3.7	293	4.7	316	3.3	292	6.4	-----	-----	304	3.5	328	6.7	252	5.9	-----	-----	306	6.4	-----	-----	257	5.4	296	5.2
5,000.....	-----	-----	248	6.8	-----	-----	-----	-----	-----	-----	-----	-----	347	5.4	244	9.1	-----	-----	295	5.5	-----	-----	263	6.9	-----	-----

<sup>1</sup> Navy stations.

TABLE 3.—Maximum free-air wind velocities, (meters per second) for different sections of the United States based on pilot-balloon observations during June 1938

Section	Surface to 2,500 meters (m. s. l.)					Between 2,500 and 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum ve- locity	Direction	Altitude (m), m. s. l.	Date	Station	Maximum ve- locity	Direction	Altitude (m), m. s. l.	Date	Station	Maximum ve- locity	Direction	Altitude (m), m. s. l.	Date	Station
Northeast <sup>1</sup> .....	34.0	W.....	1,750	7	Buffalo, N. Y.....	36.3	W.....	5,000	8	Cleveland, Ohio.....	36.8	W.....	5,200	8	Cleveland, Ohio.
East-Central <sup>1</sup> .....	26.4	SW.....	2,230	11	Cincinnati, Ohio.....	24.6	W.....	3,930	5	Richmond, Va.....	40.0	WNW.....	11,070	8	Nashville, Tenn.
Southeast <sup>1</sup> .....	20.3	WSW.....	630	21	Jacksonville, Fla.....	20.4	W.....	4,660	12	Spartanburg, S. C.....	20.9	WSW.....	9,160	9	Spartanburg, S. C.
North-Central <sup>1</sup> .....	32.7	NW.....	1,870	1	Bismarck, N. Dak.....	38.0	SW.....	2,630	7	Detroit, Mich.....	31.5	WNW.....	8,110	8	Fargo, N. Dak.
Central <sup>1</sup> .....	36.0	W.....	1,960	6	Indianapolis, Ind.....	30.8	WSW.....	3,690	10	Moline, Ill.....	32.0	W.....	11,070	17	Moline, Ill.
South-Central <sup>1</sup> .....	33.1	S.....	1,710	10	Abilene, Tex.....	27.6	W.....	4,070	26	New Orleans, La.....	25.0	N.....	7,850	5	Houston, Tex.
Northwest <sup>1</sup> .....	29.9	W.....	2,500	8	Missoula, Mont.....	37.0	W.....	4,720	8	Boise, Idaho.....	43.5	NNE.....	6,080	19	Medford, Oreg.
West-Central <sup>1</sup> .....	63.3	S.....	2,470	19	Modena, Utah.....	58.0	S.....	2,500	19	Modena, Utah.....	41.6	WSW.....	6,300	17	Reno, Nev.
Southwest <sup>1</sup> .....	27.3	NNW.....	1,990	13	Sandberg, Calif.....	46.2	WSW.....	3,200	9	Winslow, Ariz.....	40.8	W.....	11,660	16	Las Vegas, Nev.

<sup>1</sup> Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and northern Ohio.

<sup>2</sup> Delaware, Maryland, Virginia, West Virginia, southern Ohio, Kentucky, eastern Tennessee, and North Carolina.

<sup>3</sup> South Carolina, Georgia, Florida, and Alabama.

<sup>4</sup> Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.

<sup>5</sup> Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.

<sup>6</sup> Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and western Tennessee.

<sup>7</sup> Montana, Idaho, Washington, and Oregon.

<sup>8</sup> Wyoming, Colorado, Utah, northern Nevada, and northern California.

<sup>9</sup> Southern California, southern Nevada, Arizona, New Mexico, and extreme west Texas.

## RIVERS AND FLOODS

[River and Flood Division, MERRILL BERNARD in charge]

By BENNETT SWENSON

Severe floods occurred during June 1938, principally in the Neosho, Smoky Hill, and Osage Rivers in Kansas. Excessively heavy local showers in Montana caused disastrous, sudden floods in that State with great property damage amounting to nearly \$1,000,000 and the loss of about 58 lives, 48 of which were lost in the train wreck caused by a flood in Custer Creek, which flows into Yellowstone River about 30 miles below Miles City, Mont. High water in the San Joaquin and Columbia River basins caused considerable overflowing in those basins. A number of other floods, mostly of a minor character, also occurred with no damage of great consequence. Flood heights at all of the gaging points are shown in the accompanying table.

The following report on the floods in the Topeka, Kans., river district is submitted by the official in charge at that place:

Four overflows occurred in the Neosho River in Kansas during the month and the month preceding, one along the upper Smoky Hill, one along the Osage, one in the upper Solomon, and one in the Saline River. The first overflow of the Neosho was one that started in May and which began at Le Roy and Iola, Kans., on May 20 and by the 22d extended along the entire river below

Emporia, Kans. This was preceded by a slight overflow at Le Roy on May 13 and at Iola and Chanute, Kans., on May 14. At Neosho Rapids and Le Roy the serious May overflow had subsided by May 26 and 29, respectively, but from Iola to the Oklahoma line it continued into June. At Oswego, Kans., where the crest was 23.5 feet, 6.5 feet above bankful, on June 1, the river did not return to its banks until June 6, making a total of 15 days for the overflow at that place. While crest stages did not approach previous records at any place, the duration of this overflow caused great damage to growing crops, estimated at \$342,500, with 145,000 acres flooded. The total property loss was estimated at \$410,350. One life was lost, though not directly due to the high water.

A slight overflow of the Neosho occurred at Le Roy on June 1 and at Iola on June 1 and 2 but caused little damage.

Another overflow of the Neosho occurred in Labette County, beginning June 17. This reached a crest of 24.0 feet, 2.0 feet above bankful, at Parsons, Kans., on the 17th and 21.8 feet, 4.8 feet above bankful, at Oswego on the 18th. Damage from this overflow totalled \$28,000, being mostly to crops and livestock.

Heavy rains that totalled 5.33 inches at Council Grove, Kans., fell along the upper reaches of the Neosho River on June 10 and resulted in a disastrous overflow in that city and downstream to the junction of the Neosho with the Cottonwood River. Damage from this overflow was estimated at \$314,806 the greater part of which was to property in Council Grove, and to growing crops. At Neosho Rapids, just below the mouth of the Cottonwood River, the highest stage measured was 22.8 feet, 0.8 foot above bankful, on the evening of the 12th, at which time the river was believed to

have fallen about 10 inches. No overflow occurred at Le Roy, the next gage below Neosho Rapids.

The overflow along the upper Smoky Hill was one of the greatest ever known in the vicinities of Ellsworth, Lindsborg, and Salina, Kans. This was due to torrential rains the closing days of May. At Ellsworth the crest was 27.2 feet, 7.2 feet above bankful, at 11 a. m. of June 1. The previous highest stage of record at Ellsworth was 25.75 feet, August 13, 1927. At Lindsborg the crest was 32.5, 11.5 feet above bankful, at 1:55 a. m. of June 3. This compares with 34.5 feet in the great overflow of 1903 at that place. At Mentor, Kans., a crest of 26.1 feet was reported at 11:30 a. m. of June 4, which compares with 26.5 feet in 1903. At Salina the crest was 23.23 feet, 3.23 feet above bankful, at 7 p. m. of June 5, which is the greatest at that place since the flood of 1903, when a crest stage of 24.6 feet occurred. This overflow extended only a comparatively short distance below Salina. At Enterprise, the first gage downstream, the river remained within its banks.

The total damage in Russell, Ellsworth, McPherson, and Saline Counties was estimated at \$894,000, the greater part of which was to buildings, highways, and bridges, and to growing crops, of which latter more than 30,000 acres were flooded.

The overflow along the Osage River began June 11 in Osage County and was general to the Missouri line by the following morning. The crest at Ottawa was 29.0 feet, 5.0 feet above bankful, on June 13 and at La Cygne, 25.4 feet, 4.4 feet above bankful, two days later.

Damage from this overflow was estimated at \$229,000, most of which was to matured and prospective crops of which latter 17,000 acres were flooded in Franklin and Linn Counties.

The State Highway Commission estimated damage to highways and bridges in Kansas due to heavy rains and overflows during the latter part of May and the fore part of June at from \$250,000 to \$350,000. This damage was widely scattered over the state.

A slight overflow of the upper Solomon River that lasted but one day occurred at Beloit, Kans., where the crest was 21.18 feet, 3.18 feet above bankful, on the 3d. Little or no damage resulted.

A slight overflow occurred in the Saline River, reaching a crest of 28.96 feet, 3.96 feet above bankful, at Tescott, Kans., on the 4th. No material damage resulted.

The official in charge at Miles City, Mont., reports as follows on the sudden flood in Custer Creek which caused the disastrous train wreck on the night of June 18-19th:

Custer Creek flows into the Yellowstone River about 30 miles below Miles City, Mont. Its general direction is from northwest to southeast. Most of the time it carries little or no water. It rises in a range of hills which forms part of the divide between the Missouri River and the Yellowstone River drainage basins. It drains approximately 162 square miles.

On the night of June 18th a severe rain storm, accompanied by light hail and light winds, formed at the head of this creek, later moving northeastward over Cherry Creek. It was plainly visible from Miles City but not a trace of rain fell there. Some observers report two storms, one about 4 p. m. and the other beginning about 9 p. m. Most reports agree that the greater portion of the rain fell between 9 p. m. and midnight. There were no authentic measurements made but from the contents of various containers exposed to the rain it was estimated that from four to seven inches of rain fell during this period.

The wreck of the Chicago, Milwaukee, St. Paul and Pacific Train No. 15 occurred at the bridge over Custer Creek a short distance from the Yellowstone River. The river was not high for this season, being about four feet below flood stage. Shortly after 10 p. m. of the 18th a train crossed the bridge safely, followed about 10:30 p. m. by a track walker. At that time water was flowing in the creek but was well within the banks and did not appear at all dangerous. It kept rising, however, and evidently weakened the bridge to such an extent that when Train No. 15 (The Olympian) came along about 12:40 a. m. of the 19th, it was not strong enough to support the locomotive which went down followed by 7 cars, 4 remaining on the track. The water was deep enough by this time so that one car, a tourist sleeper, was completely submerged.

The total loss of life was 48, with 64 persons injured.

Excessive rainfall in the form of a thunderstorm on the evening of June 22nd extended over all of the Bull Hook and Gravelly Coulee drainage basins in Hill and Blaine Counties. Rainfall was measured in this area as follows: Big Sandy, 3.68 inches; Harlem, 2.75 inches; North Montana Experiment Station, 1.12 inches; and Bearpaw Lease, 2.13 inches (on June 21). Bull Hook Creek, which runs through Havre, Mont., rose quickly to flood stage

and inundated most of the city with water 2 to 3 feet deep. On the west slope of the Bearpaw mountains the water filled Gravelly Coulee and advanced with great force, taking a toll of nine lives and causing great property damage. The damage to property in Havre and immediate vicinity has been estimated at \$270,000. Other damaging floods occurred in this vicinity in December 1896, April 1899, February 1916, December 1917, May 1927, and January 1935, but none were as destructive as this flood.

An overflow of the Kings River in California occurred from May 24 to June 12. An additional 9,400 acres were flooded in the Tulare Lake Basin, due to the breaking of the levees, increasing the Lake area to about 142,000 acres. The losses to prospective crops, machinery, and including expenditures on levee building are estimated at \$10,000,000.

A report on the high water in the lower San Joaquin River during May and June by the official in charge, Sacramento, Calif., follows:

The snow depths in the Sierra Nevada Mountains at the end of the rainfall season, near the end of March, were greater than for many years past. This, together with the fact that the March rains left the streams high at the beginning of the spring melting season, accounts for the unusually high water during May. However, no flood stages were reached, except in the lower San Joaquin late in the month.

The flood stage of 17.0 feet was reached at Lathrop, Calif., on May 29, and the river continued to rise gradually as increasingly high temperatures rapidly melted the snow over the headwaters of the several eastern tributaries of the San Joaquin.

The crest at Lathrop was 20.4 feet on June 9th. This stage is not only the highest of record for any previous spring and summer snow-melting season, but with the exception of 22.5 feet in February 1911, and 20.9 feet on March 16, 1938, it stands as the highest for the entire period of record since the station was established in 1904.

There were 22 days when the river at Lathrop was above the 17-foot flood stage, establishing the longest flood period of record, except that of June 1911.

The June 1938 flood was practically a repetition of the conditions that occurred in March of this year. Nearly the same acreage was flooded. In the vicinity of the confluence of the Stanislaus and the San Joaquin rivers the previous breaks in the levees had not been repaired on account of anticipated high water with the melting of snow in the late spring.

As most of the crop damage had already been done in the March flood, the losses for the June period of high water were comparatively light, totaling about \$100,000.

A violent thunderstorm, accompanied by intensive rainfall over a period of 20 minutes, on the afternoon of June 22, occurred in the vicinity of the village of Pilot Rock, Umatilla County, in northeastern Oregon. The excessive rainfall caused a wave of water 4 to 6 feet deep to overwhelm the village, resulting in damages estimated at \$200,000. The cooperative observer measured 0.70 inch of rain during 5 minutes of the storm and estimated that 2.50 inches fell during the 20 minutes' duration of the storm. The rain gage was washed away during the flood.

The official in charge, Portland, Oreg., reports as follows on the annual rise in the Columbia River:

Average monthly temperatures for Idaho, Oregon, Washington east of the Cascades, and western Montana were above normal every month December to April, inclusive, except March when they were slightly below. Normal to above normal temperatures were also the rule for the Canadian portion of the Columbia drainage for the entire period. The weather was cool the first week in April, thereafter temperatures rose, the night readings being well above freezing in elevated sections for about 6 days. All reporting river stations began to show a substantial rise by April 10th, and no gaging station showed a lower stage until the crest of the summer rise was reached.

The precipitation by months, except for January, was mostly above average over the entire Columbia basin for the 7 months' period September 1st to March, inclusive. This was the heaviest seasonal amount for Oregon since 1893-94. The same situation

prevailed over most of the northwest, including western Montana and northwestern Wyoming. Average precipitation for Idaho as compared with the normal was as follows:

	Percent of normal
December.....	161
January.....	82
February.....	105
March.....	188
April.....	102

In March the precipitation for southwestern Idaho was 245% of the normal and for the southeast 222%. A similar condition occurred in Canada, only for different months. In the Monthly Weather Map for the Dominion of Canada for February 1938 a paragraph referring to precipitation contains the following statement: "moderate excesses above normal were generally reported while in the Okanagan, Kettle, and Kootenay valleys precipitation ranged from slightly above normal to more than three times the normal amount." In the same publication it is also noted that the excess in temperature above average in the Kettle and west Kootenay valleys ranged from 1 degree to 3 degrees while there was a negative departure for the east Kootenay and upper Columbia of from 2 degrees to 5 degrees.

Snow reports were secured from the following sources: The Water Rights Branch, Department of Public Lands, Victoria, B. C.; The Dominion Water Power Bureau, Vancouver, B. C.; The Bureau of Agricultural Engineers, Boise, Idaho, and Medford, Oreg.; and the Weather Bureau Offices, Boise, Cheyenne, Wyo.; Helena, Mont.; and Seattle, Wash.

Weekly snow reports from the Weather Bureau Offices at Boise, Helena, and Seattle, together with monthly tabulations from the first two stations, supplemented with reports from the offices of the Bureau of Agricultural Engineers, provided a frequent check on the snow situation as the season progressed. Reports from high elevations were very scarce.

High water caused considerable damage to crops and dykes in the Kootenai valley, while in the lower Columbia, flood waters resulted only in loss of pastures and prevented early planting of low lying fields. The total losses are estimated at more than \$300,000.

Estimated flood losses by drainage basins during June 1938 are given in the following table:

Atlantic Slope drainage:	
Roanoke River.....	\$99, 000
Neuse River.....	26, 000
Tar River.....	20, 000
Upper Mississippi Basin:	
Chippewa River.....	27, 000
Mississippi River.....	22, 200
Missouri Basin:	
Rivers in Montana.....	1, 000, 000
Smoky Hill River.....	894, 000
Republican River.....	13, 000
Osage River (Kansas).....	229, 000
Arkansas Basin:	
Little Arkansas River.....	9, 500
Neosho River.....	753, 156
Pacific Slope drainage:*	
San Joaquin River.....	106, 500
Columbia River.....	531, 385
Total.....	3, 730, 741

\*An estimated loss of \$10,000,000 caused by the spring and summer overflow in the Tulare Lake Basin is not included.

The following report on the flood in the headwaters of the Mississippi River during May is submitted by the official in charge, Minneapolis, Minn., as follows:

The May 1938 flood in the extreme upper Mississippi River was the result of a prolonged period of heavy rains that began on April 14 and continued almost daily until May 13.

There is a total of 26 rain gaging stations in the drainage area above Minneapolis, which measures 19,680 square miles, and the average catch of these rain gages for the entire 30-day period was 8.10 inches. As this portion of the Mississippi River is a prairie and woodland stream with low banks and of only moderate width, vast areas of low lands along the main stream are inundated in floods. On the first of May the river was well within its banks, but the continued rains raised the stages above the flood limits on May 6 at Aitken and Fort Ripley, Minn., the two upper gaging stations.

The river crested at Aitken on May 12, with a stage of 15.7 feet, 3.7 feet above flood stage, and at Fort Ripley on May 11 with a stage of 10.8 feet, 0.8 foot above flood stage, as shown in the table below. Flood stage was not reached at Minneapolis or St. Paul; the crest at the former place being 15.0 feet on May 12 and 13, flood stage 16 feet; and at the latter place the crest was 11.2 feet on May 14, flood stage 14 feet.

Table of Flood Stages in Upper Mississippi River During May 1938

Station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
Aitken, Minn.*	12	6	28	15.7	12
Fort Ripley, Minn.	10	9	19	10.8	11
Minneapolis, Minn.	16			15.0	12, 13
St. Paul, Minn.*	14			11.2	14

\*Records from U. S. Engineer Office.

Crop losses, confined principally to meadows and hay lands, are placed at \$55,000. The major damage was to highways with losses estimated at \$1,000,000.

Table of flood stages during June 1938

[All dates in June, unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ST. LAWRENCE DRAINAGE					
Lake Erie					
Maumee: Fort Wayne, Ind.-----	Feet 15	27	27	Feet 15.2	27
ATLANTIC SLOPE DRAINAGE					
Schuylkill: Reading, Pa.-----	7	28	28	7.1	28
James: Columbia, Va.-----	10	20	24	14.8	21
Roanoke:					
Randolph, Va.-----	21	21	24	25.2	23
Weldon, N. C.-----	31	21	26	39.9	24
Williamston, N. C.-----	10	29	(?)	31.7	30
Tar:		24	(?)	12.5	29
Rocky Mount, N. C.-----	8	21	26	10.5	25
Tarboro, N. C.-----	18	25	28	19.5	27
Greenville, N. C.-----	13	24	(?)	15.3	29
Neuse:					
Neuse, N. C.-----	14	21	26	17.6	25
Smithfield, N. C.-----	13	20	28	16.3	27
Goldsboro, N. C.-----	14	24	(?)	(8)	
Kinston, N. C.-----	14	30	(?)	(8)	
Santee: Rimini, S. C.-----	12	5	5	12.0	5
MISSISSIPPI SYSTEM					
Upper Mississippi Basin					
Chippewa: Durand, Wis.-----	11	2	5	12.5	3
Rock: Moline, Ill.-----	10	26	28	10.3	27
Skunk: Augusta, Iowa.-----	15	15	16	17.0	16
Bourbeuse: Union, Mo.-----	12	11	14	20.2	13
Meramec:					
Pacific, Mo.-----	11	11	15	19.7	12
Valley Park, Mo.-----	14	11	15	23.9	12
Mississippi:					
Keokuk, Iowa-----	12	1	9	13.0	3
		15	17	13.2	16
Quincy, Ill.-----	14	2	10	15.0	4, 7, 8
		15	18	14.9	17
Hannibal, Mo.-----	13	May 20	20	15.0	7, 8
Louisiana, Mo.-----	12	May 22	20	13.7	9
Missouri Basin					
Solomon: Beloit, Kans.-----	18	2	3	21.2	3
Smoky Hill:					
Ellsworth, Kans.-----	20	1	2	27.2	1
Lindsborg, Kans.-----	21	1	5	32.5	3
Salina, Kans.-----	20	4	7	23.2	5
Osage:					
LaCygne, Kans.-----	21	12	18	25.4	15
Ottawa, Kans.-----	24	12	14	29.0	13
Osceola, Mo.-----	20	May 25	3	24.9	May 30
Missouri: St. Charles, Mo.-----	25	12	12	25.4	12
Ohio Basin					
West Fork of White:					
Anderson, Ind.-----	10	26	29	13.7	27
Noblesville, Ind.-----	14	28	28	14.8	28
Elliston, Ind.-----	18	29	29	13.0	29
Edwardsport, Ind.-----	12	2	6	13.5	5
		28	(?)	15.2	July 1
Wabash:					
Wabash, Ind.-----	12	26	30	16.9	27
LaFayette, Ind.-----	11	26	(?)	18.9	29
Covington, Ind.-----	16	28	(?)	21.5	30
Terre Haute, Ind.-----	14	30	(?)	(8)	
Ohio: Cairo, Ill.-----	40	May 29	3	41.2	May 31-1

1 Fell slightly below flood stage on the 22d.

2 Continued at end of month.

3 Crest not reached.

Table of flood stages during June 1938—Continued

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
MISSISSIPPI SYSTEM—continued					
White Basin					
White:	Feet			Feet	
Georgetown, Ark.....	21	May 28	8	22.7	1
Clarendon, Ark.....	26	2	13	27.0	7, 8, 9
Arkansas Basin					
Little Arkansas: Sedgwick, Kans.	18	25	26	23.8	25
Cimarron: Perkins, Okla.....	11	{ 1	1	11.2	1
		11	11	11.0	11
		21	21	11.1	21
Neosho:					
Neosho Rapids, Kans.....	22	12	13	22.8	12
LeRoy, Kans.....	23	May 31	1	25.3	1
Iola, Kans.....	15	May 20	2	20.5	May 24
		May 22	5	23.5	1
Oswego Kans.....	17	{ 7	9	20.8	9
		16	19	21.8	18
				12.6	May 22
North Canadian: Yukon, Okla....	8	May 19	29	{ 11.2	4
				10.1	21
Arkansas:					
Fort Smith, Ark.....	22	13	13	22.0	13
Van Buren, Ark.....	22	13	13	22.3	13
Red Basin					
Sulphur:					
Ringo Crossing, Tex.....	20	8	13	28.0	9
Naples, Tex.....	22	12	19	25.6	14
WEST GULF OF MEXICO DRAINAGE					
Brazos: Waco, Tex.....	27	17	17	27.5	17

Table of flood stages during June 1938—Continued

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
GULF OF CALIFORNIA DRAINAGE					
Colorado Basin	Feet			Feet	
Eagle: Eagle, Colo.....	5	{ May 29 13 21	10 15 24	5.9 5.2 5.3 6.2	6 14 22, 23 May 30
Roaring Fork: Carbondale, Colo..	5	May 28	( <sup>1</sup> )	{ 6.7 6.5 6.3 11.2	{ 6 13 23 May 30
Gunnison: Delta, Colo.....	9	{ May 27 13 21	9 14 24	10.8 9.7 9.7	4, 5 14 22
Colorado: Grand Junction, Colo..	11	4	8	11.3	5-7
PACIFIC SLOPE DRAINAGE					
San Joaquin Basin					
Kings: Piedra, Calif.....	10	May 24	12	13.2	4
San Joaquin: Lathrop, Calif.....	17	{ May 29 19	16 21	20.4 17.2	7, 9 20, 21
Columbia Basin					
Kootenai: Bonners Ferry, Idaho..	31	May 29	1	31.5	May 30
Clearwater: Kamiah, Idaho.....	12	{ May 25 6	4 6	14.6 12.0	May 29 6
Willamette: Portland, Oreg.....	18	May 29	16	20.8	1-2, 9-11
Columbia: Vancouver, Wash.....	15	May 26	( <sup>1</sup> )	21.5	10

\* Continued at end of month.

## WEATHER ON THE ATLANTIC AND PACIFIC OCEANS

[The Marine Division, I. R. TANNEHILL in charge]

## NORTH ATLANTIC OCEAN, JUNE 1938

By H. C. HUNTER

*Atmospheric pressure.*—The pressure averaged slightly to moderately higher than normal over nearly all of the North Atlantic, but from the vicinity of the Azores northward and northeastward it was lower than normal. The greatest station departure of the month was 0.14 inch below normal at Reykjavik, Iceland. The first 8 days and the period from the 19th to the end of June were marked by low pressure most of the time from Icelandic waters to the region around the British Isles.

The highest vessel pressure reading yet found is 30.63 inches, during the forenoon of the 10th, noted on the American steamship *Edward L. Doheny*, near latitude 50° north, longitude 23° west. The lowest vessel reading is from the wireless report of an unidentified vessel near the Orkney Islands, just before noon of the 29th, 28.94 inches. However, for the 28th and the latter part of the 27th no vessel reports are at hand from the vicinity of the Orkney and Shetland groups, and table 1 shows a reading lower by more than a quarter of an inch at Lerwick on the 28th.

TABLE 1.—Averages, departures, and extremes of atmospheric pressure (sea level) at selected stations for the North Atlantic Ocean and its shores, June 1938

Stations	Average pressure	Departure	High-est	Date	Low-est	Date
	<i>Inches</i>	<i>Inch</i>	<i>Inches</i>		<i>Inches</i>	
Julianehaab, Greenland.....	29.77	-0.09	30.06	29	29.32	3
Reykjavik, Iceland.....	29.74	- .14	30.15	14	29.32	28
Lerwick, Shetland Islands.....	29.74	- .06	30.18	17	28.67	28
Valencia, Ireland.....	30.00	.00	30.48	13	29.18	28
Lisbon, Portugal.....	30.09	+ .06	30.27	9	29.86	7
Madeira.....	30.13	+ .06	30.27	9	29.90	24
Horta, Azores.....	30.23	- .01	30.44	27	30.00	15
Belle Isle, Newfoundland.....	29.93	+ .07	30.34	17	29.40	22
Halifax, Nova Scotia.....	29.99	+ .02	30.32	11	29.74	6, 26
Nantucket.....	29.99	+ .01	30.40	10	29.80	5
Hatteras.....	30.03	+ .02	30.30	10	29.84	22
Bermuda.....	30.20	+ .07	30.34	10, 11	29.84	2
Turks Island.....	30.05	+ .02	30.11	27, 28	29.97	1, 2, 14, 15
Key West.....	30.03	+ .04	30.13	10	29.87	3
New Orleans.....	30.03	+ .05	30.21	12	29.85	2

NOTE.—All data based on a. m. observations only, with departures compiled from best available normals related to time of observation, except Hatteras, Key West, Nantucket, and New Orleans, which are 24-hour corrected means.

*Cyclones and gales.*—June normally is one of the quietest months on the North Atlantic, but this year it was less quiet than usual, and there was marked contrast with the especially placid June of 1937.